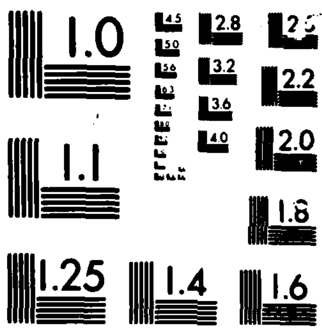
AD-A167 255 JOINT ARMY AVIATION/AIR FORCE DEEP OPERATIONS AT NIGHT: 1/1
IS IT TACTICALLY..(U) ARMY COMMAND AND GENERAL STAFF
COLL FORT LEAVENWORTH KS C H PEARSON 27 NOV 85

UNCLASSIFIED F/G 15/7 NL



MICROCOP' CHART

Joint Army Aviation/Air Force Deep Operations At Night: Is It Tactically Feasible and If So, How?

(2)

by
Major Craig H. Pearson
Aviation

School of Advanced Military Studies
U.S. Army Command and General Staff College
Fort Leavenworth, Kansas

27 November 1985

Approved for public release; distribution is unlimited.

86-2189

SECURITY CLASSIFICATION OF THIS PAGE

AD-A167255

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE

3. DISTRIBUTION / AVAILABILITY OF REPORT
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED.

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
School of Advanced Military Studies

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION
US ARMY COMMAND AND GENERAL STAFF COLLEGE

6b. OFFICE SYMBOL *(If applicable)*
ATZL-~~SWE-GD~~ SWV

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS *(City, State, and ZIP Code)*
FORT LEAVENWORTH, KANSAS
66027-6900

7b. ADDRESS *(City, State, and ZIP Code)*

8a. NAME OF FUNDING / SPONSORING ORGANIZATION

8b. OFFICE SYMBOL *(If applicable)*

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c. ADDRESS *(City, State, and ZIP Code)*
Army Aviation/Air Force

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE *(Include Security Classification)*
JOINT DEEP ~~AIR~~ OPERATIONS AT NIGHT: IS IT TACTICALLY FEASIBLE AND IF SO, HOW?

12. PERSONAL AUTHOR(S)
PEARSON, CRAIG H., MAJ, US ARMY

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
MONOGRAPH	FROM ____ TO ____	1985 NOVEMBER 27	55

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
DEEP OPERATIONS · ATTACK HELICOPTER
NIGHT COMBAT · NIGHT VISION
JOINT OPERATIONS

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This study addresses the feasibility of executing joint deep air operations in a dense anti-aircraft environment. It identifies some proven tactics and techniques for use in these operations, placing particular emphasis on night operations facilitated by equipment which is currently being tested and fielded.

To test the hypothesis that joint deep air operations are feasible in a dense anti-aircraft environment, this study examines it first from a historical perspective. General lessons are drawn from operations conducted from 1945-1973. A more detailed study is made of the Israeli experience in the Beqa'a Valley of Lebanon, the British and Argentine experiences in the Falklands and the U.S. experiences in Grenada. An indepth analysis of the Soviet air defense artillery (ADA) network is also done and compared with the

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL
Maj Craig H Pearson

22b. TELEPHONE *(Include Area Code)*
(913)684-3345

22c. OFFICE SYMBOL
ATZL-SWV

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

current and near term (1990) U.S. technology and tactics to identify weaknesses.

Conclusions drawn by this study indicate unequivocally that it is feasible to conduct both fixed wing and helicopter deep operations if these operations are properly planned, prepared and resourced. Losses to ADA will be acceptable over time but can reach 40-50% if heavily defended targets are attacked without these prerequisites being satisfied. Night operations provide U.S. forces a tremendous advantage over Soviet and Soviet-equipped forces due to their lack of comparable night vision equipment. Mines delivered by either aircraft or artillery (particularly MLRS due to its 30 kilometer range) would be extremely effective in the deep operations especially at night and should usually be an integral part of their execution. Significant coordination is required between the Air Force and the Army elements to properly execute a joint deep air operation. Timely acquisition and dissemination of accurate intelligence is essential. Joint operating procedures and training are needed to prepare both forces for this somewhat difficult but lucrative mission. Air Battle Management including airborne early warning and electronic warfare assets must be a part of most joint deep air operations. As the new fully night capable equipment is fielded manning and therefore management of these assets will become a major problem. The realization of the maximum benefits of joint deep air operations will not be possible without a significant change in both our manuals and our mindset.

Although many of the issues addressed by this study warrent further attention, the major unresolved issue is the question of timing. Delays in intelligence and in the tasking of Air Force assets in a timely enough manner to properly plan and execute an operations of this type before the target is either lost, becomes irrelevant or reaches the forward edge of the battle area is currently suspect.

Joint Army Aviation/Air Force Deep Operations At Night: Is It Tactically Feasible and If So, How?

by
Major Craig H. Pearson
Aviation

School of Advanced Military Studies
U.S. Army Command and General Staff College
Fort Leavenworth, Kansas

27 November 1985

86-2189

School of Advanced Military Studies

Monograph Approval

Name of Student: Craig H. Pearson, Major, Aviation

Title of Monograph: Joint Army Aviation/Air Force Deep Air Operations At Night: Is It Tactically Feasible and If So, How?

Approved by:

Kenneth G. Carlson
________________________________, Seminar Leader
LTC Kenneth G. Carlson, M.F.A.

Richard Hart Sinnreich
________________________________, Director, School of Advanced Military Studies
COL Richard Hart Sinnreich, M.A.

Philip J. Brookes
________________________________, Director, Graduate Degree Programs
Philip J. Brookes, Ph.D.

Accepted this 31st day of December 1985.

RE: Correct Title for Report
Use the title on the front cover.
Per Capt. Pusey, ACSC/SAMS

Accesion For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

QUALITY INSPECTED 3

ABSTRACT

Joint Deep Air Operations At Night: Is It Tactically Feasibile and If So, How? by Major Craig H. Pearson, USA, 55 pages.

This study addresses the feasibility of executing joint deep air operations in a dense anti-aircraft environment. It identifies some proven tactics and techniques for use in these operations, placing particular emphasis on night operations facilitated by equipment which is currently being tested and fielded.

To test the hypothesis that joint deep air operations are feasible in a dense anti-aircraft environment, this study examines it first from a historical perspective. General lessons are drawn from operations conducted from 1945-1973. A more detailed study is made of the Israeli experience in the Beqa'a Valley of Lebanon, the British and Argentine experiences in the Falklands and the U.S. experiences in Grenada. An indepth analysis of the Soviet air defense artillery (ADA) network is also done and compared with the current and near term (1990) U.S. technology and tactics to identify weaknesses.

Conclusions drawn by this study indicate unequivocally that it is feasible to conduct both fixed wing and helicopter deep operations if these operations are properly planned, prepared and resourced. Losses to ADA will be acceptable over time but can reach 40-50% if heavily defended targets are attacked without these prerequisites being satisfied. Night operations provide U.S. forces a tremendous advantage over Soviet and Soviet-equipped forces due to their lack of comparable night vision equipment. Mines delivered by either aircraft or artillery (particularly MLRS due to its 30 kilometer range) would be extremely effective in the deep operations especially at night and should usually be an integral part of their execution. Significant coordination is required between the Air Force and the Army elements to properly execute a joint deep air operation. Timely acquisition and dissemination of accurate intelligence is essential. Joint operating procedures and training are needed to prepare both forces for this somewhat difficult but lucrative mission. Air Battle Management including airborne early warning and electronic warfare assets must be a part of most joint deep air operations. As the new fully night capable equipment is fielded manning and therefore management of these assets will become a major problem. The realization of the maximum benefits of joint deep air operations will not be possible without a significant change in both our manuals and our mindset.

Although many of the issues addressed by this study warrant further attention, the major unresolved issue is the question of timing. Delays in intelligence and in the tasking of Air Force assets in a timely enough manner to properly plan and execute an operations of this type before the target is either lost, becomes irrelevant or reaches the forward edge of the battle area is currently suspect.

Table of Contents

Page

Title Page i
Monograph Approval ii
Abstract iii
Table of Contents iv

Section I. Introduction 1
Scope 2
Methodology 2

II. Historical Perspective 3
General 3
Beqa'a Valley 4
The Falklands 7
Grenada - Operation Urgent Fury 12
Summary 15

III. Soviet Air Defense Artillery Network 15
General 15
Mission 15
Concepts 15
Capabilities 16
ADA Units and Systems 16
The Gap 17
Helicopter Intercepters 18
Summary 21

IV. Technology 21
Air Force Systems 21
LANTIRN 21
Precision Munitions 23
Mines 24
Army Systems 24
APACHE 24
C-NITE 25
NVGs 26
Mines 27
MLRS 28
Summary 28

V. Conclusions 30
Relevance 30
Feasibility 30
Night Operations 30
Mines 31
Missions 32
Army Aviation 32
Air Force 33
Intelligence 33
Coordination 34
Command and Control 35
Air Battle Management 36
Airspace Management 37
Joint Training 37

Manning.................................. 37
Doctrine, Manuals and Mindset........... 38
Summary.................................. 38

VI. Unresolved Issues........................ 39

Endnotes... 41
Bibliography............................. 44

I. INTRODUCTION

Deep operations are an integral and essential component of AirLand Battle Doctrine. According to Lieutenant Colonel L. D. Holder, one of the authors of both the August 1982 version and the current draft of Field Manual 100-5:

> Emphasis on operations in depth is one of the principal features of the current doctrine. ...deep attack compliments the central concept of the operation. It is neither a side show nor an optional activity without importance to the outcome of the battle. It is an inseparable part of a unified plan of operations.[1]

Field Manual 100-5 confirms that deep operations are "an integral part of the overall plan: they selectively attack vulnerable enemy forces and facilities as a synchronized part of the tactical effort." Deep operations are designed to limit the enemy's freedom of action, alter the tempo of operations and isolate the battlefield to suit the commander's plan. In the offense, deep operations are used to isolate, immobilize, weaken, and prevent reorganization of the defenders in depth by blocking reinforcements and preventing withdrawal. In the defense, deep operations are used to prevent the concentration of overwhelming combat power at a place unsuitable to the commander's plan.[2]

Deep operations are executed at every level of command by a variety of forces and systems including electronic warfare, long range fires (cannon, rocket and missile artillery), Army aviation assets of the division and corps combat aviation brigades, and Air Force battlefield air interdiction (BAI) and air interdiction (AI). Because of its speed, survivability, and destructive capability BAI is the mainstay of the day-to-day deep operation. The inherently long lead-time associated with Air Force assets and the requirement for precise intelligence for targeting are, however, significant drawbacks. Army aviation assets may offer a viable alternative or addition to BAI. Lieutenant

Colonel Holder states:

> The fastest, but most temporary, intervention in the enemy rear can be accomplished by attack helicopter units. Fighting as companies or battalions, attack helicopter units have the range, speed and killing power to strike enemy reserves, artillery and convoys very effectively. When employed as part of a joint air attack team with Air Force aircraft, their effectiveness will be even greater.3

As will be shown later, the United States appears to have a large technological edge in night vision optics. If so, execution of deep operations at night and perhaps during other periods of limited visibility may offer a significant advantage.

SCOPE

This monograph addresses the feasibility of executing joint deep air operations in a dense anti-aircraft environment. It will also attempt to identify proven tactics and techniques for use in these ooerations. The apportionment and allocation of Air Force assets is beyond the scope of this monograph and will not be considered.

METHODOLOGY

These propositions will be addressed first from a historical perspective. General lessons will be drawn from operations conducted from 1945 -1973. A more detailed study will be made of the Israeli experience in the Beqa'a Valley of Lebanon, the British and Argentine experiences in the Falklands and the U.S. experience in Grenada.

An indepth analysis of the Soviet air defense artillery (ADA) network will be conducted to identify any exploitable weaknesses. The current and near term (1990) U.S. technology, equipment and tactics which may be used to take advantage of these weaknesses will be specified. A comparison of these areas will determine the feasibility of operating against the Soviet ADA network with both Air Force

and Army aviation assets. From these findings recommendations will be made as to the feasibility and appropriate tactics to be used in joint deep air operations conducted during limited visibility.

II. HISTORICAL PERSPECTIVE

General: 1945-1973

There has been little relative improvement in ADA in recent history. The general impression that ADA capabilities have been steadily improving and are approaching the point of being able to "sweep the skies" is simply not supported historically. Technological advances in ADA systems have been offset by commensurate advances in aircraft survivability and tactics. Since 1945, the loss rates of aircraft from ADA has hovered around 2% if considered over any appreciable segment of a war. Of these losses, 80-83% were hit by anti-aircraft artillery or groundfire rather than surface-to-air missiles (SAMs).[4] Even in Vietnam these figures are born out. Although we lost 3,700 fixed-wing aircraft and 4,900 helicopters between 1965 and 1972, it is noteworthy that the loss rate fell from 3.5 per 1,000 sorties in 1966 to 1.5 per 1,000 in 1968. The F-105, which bore the brunt of the action over North Vietnam, received only one hit for every 90 sorties flown and that hit rarely destroyed the aircraft. The B-52s flying against Hanoi during the Christmas Offensive of 1972 faced the best defended city in history and were attacking over known routes at high altitudes. 740 sorties were flown between 18 and 29 December 1972. Of the more than one thousand SAMs launched against the bombers, only eighteen were hits, downing fifteen B-52s and damaging three more. Of the 7,500 bombing sorties flown by B-52s from 1966-72 over North Vietnam a total of only seventeen bombers were lost for a loss rate of 2.3 per one-thousand completed sorties. The SA-2 kill rate for the entire war averaged one aircraft hit per 100 fired.[5]

Helicopter losses during that war were even lower. For the entire war, helicopters suffered only one hit for every 450 sorties and one helicopter lost every 7,000 sorties.

During the Tet Offensive of 1968, when ground fire was at its peak, only one helicopter was lost for every 1,000 sorties.[6]

This war, however, pitted a backward nation against the most technologically advanced nation in the world. Perhaps a better example would be the 1967 and 1973 Middle East Conflicts. Even though the weather and terrain of the region are very favorable to ADA systems, the Israeli Air Force (IAF) lost only 1.4 per cent of its sorties in 1967 and 1.1 per cent in 1973. Overall, 50-55 SA6s were fired to hit one aircraft and approximately 4,350 SA7s downed only two and damaged thirty other aircraft. It is true, however, that in the early days of the 1973 Yom Kippur War the IAF bravely but fool-heartedly disregarded the Arab air defenses and suffered 30-40 per cent losses on close air support during the first 72 hours. But herein lies the key: the best ADA networks have always been defeated. Innovative tactics which optimize the latest technology usually succeed. When coupled with detailed planning based on accurate intelligence, attacks seldom fail and losses are acceptable. When heavily defended targets are attacked without adequate preparation or suppression, or when attacking aircraft are not equipped with the appropriate survivability equipment, losses may be as high as 40-50%.[7]

Although these examples do not directly correlate to the joint operations discussed by this paper, they do point out that over time, and in the worst environments, aircraft have been able to successfully penetrate enemy air defense networks and accomplish their missions. To determine if these observations are still true today the more recent cases of the Israeli Air Force (IAF) in the Beqa'a Valley of Lebanon, the British and Argentine conflict in the Falklands and the U.S. experience in Grenada will be analyzed in terms of feasibility and findings.

BEQA'A VALLEY

Feasibility: In the Israeli attack into the Beqa'a Valley in June 1982, the Israeli Air Force (IAF) destroyed seventeen of nineteen SA-6 sites and numerous Syrian MIGs in one coordinated and well rehearsed raid. The IAF returned a

short time later to destroy the remaining SA-6 sites, completing the destruction of the entire ADA network. The most remarkable aspect of the operation was that the IAF suffered only one jet aircraft loss and that was in a subsequent operation.[8]

These results dramatically demonstrate that, if properly prepared and executed, air attacks are feasible even against well developed ADA networks. This operation utilized a massed attack which was carefully planned and rehearsed. It was based on accurate intelligence and utilized a great deal of deception and electronic warfare. The most vital technique, however, may have been the nearly flawless operation of an extensive air battle management system.

Findings:

General: All observations drawn from the IAF experiences must be carefully tempered by the differences between the IAF and U.S. or NATO situation. The IAF faced a limited and well known theater in the Beqa'a Valley. The valley itself is only ten miles wide and twenty-five miles long. It is surrounded on three sides by 6,500 foot ridgelines which can be used to shield low flying aircraft. Furthermore, the IAF had nearly perfect intelligence and literally years to plan and months to rehearse. The targets were mobile systems which neither moved nor hardened their positions. The ADA network, while typically Soviet, was not a totally mature umbrella, lacking some longer range and newer, more sophisticated systems. This is not to say that the attack could not have worked against a mature, European ADA network. Indeed, many of the IAF techniques are being studied and adopted by the U.S. Air Force.[9] But to draw direct conclusions from this operation alone without careful consideration for differences in circumstances and environment would be unwise.

Initiative: The IAF maintained the initiative throughout the war, leaving the Syrians to feebly react to their attacks and suffer devastating losses. Benjamin S. Lambeth of the Rand Corporation writes:

> What made the critical difference was the

> IAF's constant retention of the initiative and its clear superiority in leadership, organization, tactical adroitness and adaptability. This is the overarching "lesson" of enduring merit from the war - and the last ones the Soviets seem close to recognizing and assimilating.[10]

Colonel William R. Hochensmith of the U.S. Air Force, writing for the Air University Review, states:

> A requisite of Israeli strategy was to seize the initiative, the offensive, and with it control of the timing, direction, and magnitude of the conflict. Syria could merely react. (The plan had) well defined limits with specific objectives that were easily recognized, well understood, and eminently achievable. All assets ... were integrated and subordinated in a unified plan that employed each in a way calculated to gain the greatest effectiveness from the synergistic capability of the whole.[11]

Colonel Hockensmith goes on to observe that attention to detail, precise coordination and proper delegation of authority to the appropriate mission commanders with authority to abort at a critical point in the execution was also important.

<u>Air Battle Management</u>: The precise coordination and proper delegation of authority was made possible by another key element, the air battle management system. This svstem, operating from an E2C surveillance aircraft was closely linked and coordinated with the electronic warfare package controlled from an RC707. Its surveillance capability was supplemented by the on-board radar on some designated F-15s. The E2C was able to relay real time information through a redundant communication system to the subordinate air battle managers, providing them sufficient data for timely and accurate decisions in spite of enemy jamming. The RC 707,

supplemented by numerous ground and airborne jammers, was able to completely sever the Syrian's Soviet-style command and control which consisted primarily of vectors from a ground controller, resulting in great confusion and vulnerability on the part of the Soviet-trained Syrian pilots. It was clear throughout the battle that the deception effort and the electronic warfare plan were highly synchronized and contributed significantly to the successful operation.

Weapons: In the actual destruction of the SA-6 sites the IAF made excellent use of stand-off weapons of both the laser-guided and radiation-seeking type. The intent was not to destroy all the missiles initially, but to destroy the critical and vulnerable radar guidance systems housed in the vans. The remaining missiles and equipment were destroyed later with area munitions after destruction of the ADA network made overflight of the missile sites feasible.

THE FALKLANDS

Feasibility: The British operations in the Falkland Islands also support the proposition that aircraft, including helicopters, can survive and accomplish their mission on the battlefield, but not without risk. Even though both sides faced a serious SAM threat, the most significant danger continued to be from gunfire.

Five British Harriers were lost to ground fire; four of the five were downed by gun fire with only one hit by a SAM (a Roland). Of the over 200 British helicopters deployed to the Falklands a total of twenty-five were lost. Included in the twenty-five losses were eight due to ground fire and eight to accidents. At least four of the eight accidents were due to weather. The remaining nine helicopters were lost when the ships on which they were based were sunk. British losses were therefore 12.5% of the helicopters involved. This may seem high but is actually less than .6 helicopters per day for the forty-two days between the time the British took their first losses on 4 May 1982 and ending with the Argentine surrender on the night of 14 June 1982. The British were able to utilize their helicopters

successfully, adding significantly to their mobility over the rugged terrain. They severely missed the Chinooks lost on the Atlantic Conveyer, flying the remaining Chinook almost non-stop for the duration. One of their major lessons learned from the conflict, however, was that helicopters, particularly unarmed helicopters, are not nearly as survivable as desired when operating in open terrain in the daylight.

According to British figures, the Argentines lost a total of 29 fixed-wing aircraft to various SAMS and ground fire. Twenty-five Argentine helicopters were also destroyed or captured. These figures are not surprising since the Argentines were flying into an extremely dense and sophisticated ADA network which usually included both the various shipboard defenses and the shore-based systems. The only missing component of a fully mature ADA network was a long range early warning net. Although most of the Argentine aircraft were as modern as the British, they lacked some of the latest survivability equipment. Some propeller-driven aircraft, such as the Pucara, were also used and are included in the fixed-wing losses. On one occasion, six Pucara' ground attack aircraft found a hole in the cloud cover which had grounded the British combat air patrol (CAP) and attacked the 2d Battalion, the Parachute Regiment (2 Para). Four of these aircraft were destroyed by machine gun fire and Blowpipe missiles (equivalent to our Stinger). Throughout the operation, British commanders expressed surprise at the effectiveness of machine guns in the air defense role.[12]

The results of the Falklands Campaign therefore support the model presented earlier with some qualifications. When utilizing adequate survivability equipment and appropriate tactics, aircraft and helicopters were able to accomplish their missions with acceptable losses even though operating in a relatively sophisticated ADA environment. Losses were heavy when attacks were made against well prepared targets by aircraft not equipped with adequate survivability measures. Helicopters from both sides, operating almost totally in the daylight, fell prey primarily to small arms fire. The

British Blowpipe also accounted for its share of the Argentine helicopters.[13] Overall, helicopters were not as survivable as desired when operating in open terrain in the daylight.

Findings:

Training: The British military as a whole demonstrated an obsession with making the best use of available time for realistic training. This became even more pronounced on the passage to the Falklands.

> The courage and professionalism demonstrated by the British were no accident. Their training instills pride, discipline and responsibility to others at the outset. It emphasizes operations in all weather and conditions. One does not win battles if he has left his aircraft on the ground, his ships in port and his troops in barracks during large periods of the training cycles.[14]

The British clearly performed well as a result of having trained for the difficult missions. During the passage, the British used every opportunity to wargame, discuss tactics and techniques and refine their small unit battle drills. Time and again their training paid off as they functioned much better both on the ground and in the air than did their adversary.

Airborne Early Warning (AEW): Recognizing a serious shortcoming in their airborne early warning system which could not be resolved, the British used a combat air patrol (CAP) over both ships and ground forces at critical times and places. Argentine aircraft still repeatedly surprised the British on land and afloat, getting through both the CAP and the ADA, delivering surface-skimming missiles and bombs. Helicopters were used to hover over major ships to decoy the surface-skimming missiles. The helicopter presented a preferable target to inbound missiles which usually guided on it rather than the ship the helicopter was protecting. As the missile neared the helicopter the pilot would suddenly

apply power to ascend above the path of the missile at a rate it could not follow. The missile would pass harmlessly under the helicopter, missing the ship. The combination of these efforts was not totally successful as the Argentines sank six British ships. This indicates the clear requirement for an airborne early warning platform and system to conduct the air battle management function.[15]

Tactical Aerial Intelligence: Throughout the preparations for and conduct of the campaign, the British suffered from a lack of aerial intelligence. This forced them to use their outnumbered resources less effectively than they would have otherwise. The lack of aircraft carriers and air fields on which to land both AEW and tactical air reconnaissance (TAR) aircraft resulted in a significant tactical disadvantage for the British and was responsible for some of their aircraft, ship and personnel losses.

Identification Friend or Foe (IFF): IFF was a constant problem for the British. This was further complicated by the interference with shipboard IFF by the ADA systems on shore. To overcome this, the on shore radars had to be turned off, reducing the system to the visual tracking mode only. To improve visual identification, returning Harriers lowered their landing gear and turned on their landing lights. The cost of on shore ADA operating without radar guidance is open to conjecture, but the fact that IFF was a problem that requires a well thought-out and coordinated solution is obvious.

Radar Jamming and Destruction: Although the British had some of the latest technology from both the U.S. and their own factories, they were never able to destroy or completely jam the highly mobile Westinghouse-built shore radar system of the Argentines. This radar system had a range of 250 nautical miles and was a significant detriment to British operations. Shrike anti-radiation missiles were relatively successful against other radars but were not able to knock out this system. Some other means is therefore needed to insure the destruction of systems of this type.[16]

Weapons: Throughout the Falklands Campaign, the Royal Air

Force (RAF) experienced heavy losses when required to overfly target areas to deliver unguided munitions. Losses dropped dramatically when smart standoff munitions were used eliminating the need for overflight. Better coordination and tactical air ground communication to properly execute the attacks with these weapons was quickly implemented. The value of stand off munitions was also clearly shown from the Argentine perspective by the successes of their sea-skimming missiles.[17]

Night Operations: Night operations on the part of the British ground forces and the lack of night operations by the Argentine Air Force had a telling, if not crucial, effect on the outcome of the conflict. During the landings at San Carlos, the Argentine Air Force broke off its attacks as night fell, allowing the British to complete their landings during darkness.[18] Throughout the war the British ground forces expertly utilized both NVGs and sniper weapons fitted with night vision sights to help overcome the enemy's numerical superiority.[19] Using both image intensification devices and thermal optics, the British found that the thermal optics were far superior during adverse weather, especially winter conditions such as snow and fog. The Argentines, however, although having some NVGs available, failed to use them, either through lack of training or distaste for night combat.[20]

Mines: The tremendous mobility differential enjoyed by the British due to their training, physical condition, helicopter support and night vision advantage was thwarted by the Argentines only through the use of mines. The Argentines enjoyed significant successes using both hand emplaced and helicopter-disbursed mines. Even when mine fields were neither extensive nor covered by fire, they resulted in significant casualties and delays to British units. On one occasion, the Welsh Guards encountered a helicopter-delivered mine field which had been emplaced after the reconnaissance for an attack. The minefield seriously delayed the attack and caused significant casualties even though it was not covered by fire. On another occasion, near Mount Williams a

British unit cleared a path through a helicopter-delivered minefield only to have it re-mined by Argentine helicopters, resulting in a six hour delay and many casualties. Here again, the minefield was not covered by fire. Low-metallic mines, which were nearly impossible to locate with mine detectors, seriously complicated mine clearing.[21]

GRENADA - OPERATION URGENT FURY

Feasibility: The U.S. operation into Grenada, while essentially a low intensity operation, still provides relevant lessons to the conduct of joint deep operations. It proved once again that aviation elements, correctly equipped and trained, can operate successfully in virtually any environment. Nine of the 107 helicopters operating in Grenada were lost to ground fire. This is within the previously presented model, particularly when it is recognized that each helicopter flew many sorties during the operation. In part, these losses resulted from a lack of attack helicopter support for air assault operations. Three helicopters were lost to small arms fire in one landing zone during an air assault conducted without attack helicopter support. We must recognize that, particularly in low intensity conflict, attack helicopters are not only tank-killers but must suppress enemy small arms and ADA. Night operations would also have significantly limited losses to ground fire.[22]

Losses were in part a result of a conscious decision to limit SEAD to minimize collateral damage. Two AH-1Ts were lost on a mission which could have better been done by artillery or TAC Air but with much greater collateral damage. Survivability was also demonstrated by one UH-60 receiving forty-five hits but completing its mission.[23]

Findings:

<u>Unity of Command/ Airspace Management</u>: From the very beginning of planning for the operation, the lack of unity of command created significant problems in force allocation and synchronization, particularly for Army aviation, and air defense and Air Force elements. Airspace management responsibilities were not clearly delineated, resulting in a

lack of coordination of IFF coding and other airspace and air defense control measures. While this was not a significant problem in the benign air environment of Grenada, it could be disastrous if opposing a more serious threat.[24]

<u>Communications</u>: Significant problems also existed with communication between services. Throughout the operation this resulted in less than satisfactory command, control and coordination both laterally and between command echelons. Lack of common communications equipment and procedures (CEOIs, common NETS, etc.) created problems which must be resolved before planning and executing future joint operations. The new family of radios (U.S.A.F. HAVE QUICK and Army SINGARS) must be compatible (or shared), secure, and highly jam resistant.[25]

<u>Intelligence Preparation of the Battlefield (IPB)</u>: The planning and conduct of individual missions was hampered by maps which were not common and resulted in significant difficulties in coordination of fire support, routes, etc. Likewise, intelligence was not disseminated in a timely manner, particularly between services, resulting in widely differing views of the situation. Very limited planning times for many missions further complicated this situation, resulting in less than optimal results.[26]

<u>Training</u>: A significant shortfall in the training of Army air crews for joint operations was identified. Although it is not directly relevant to joint deep air operations at night, it does indicate the need to think through training requirements for all joint operations. The U.S.S. Guam refused to allow U.S. Army helicopters to land at night unless they were night carrier qualified. The ship's captain felt that this represented a dangerous situation and that, because it was not a life-or-death situation, it was an unnecessary risk. Since future operations may require Army helicopter units with contingency missions to operate from or recover to a Navy ship, they must program carrier qualifications into their annual training plans, flying hour programs and budgets. This is also true of other tasks peculiar to joint deep air operations.

Manning: Deployment to Grenada by Army aviation units, followed by immediate introduction into combat, vividly displayed that crew rotation would be a critical problem in wartime. Operation Urgent Fury Assessment states:

> Twenty-four hour combat operations require well planned crew rotation. Commanders must designate day and night crews. During Urgent Fury, night operations were neither planned nor conducted. Had twenty-four hour operations been essential, aviation units would have been hard pressed to provide sufficient crews. If maneuver commanders use 100 percent of the aviation force in a single day or night situation, then the aviation force will require 12 to 36 hours to resume full and effective twenty-four hour combat operations. Initial day operations required 80 to 100 percent utilization of aircraft and crews. ...Aviation unit commanders must practice twenty-four hour operations with the maneuver force commanders in all training situations. Flying Hour Programs must include funds to train units with a twenty-four hour mission. The Army must provide aviation units with NVGs as authorized by TOEs.[27]

Although the crew rest requirements outlined above are the extremes stated in A.R. 95-1, the problem of crewing aircraft which now have an around-the-clock capability without an increase in the number of pilots and maintenance personnel is real. Experience factors indicate that the reduction in aircraft availability due to near continuous operations will not offset the shortage of crews. The current manning levels therefore force commanders to make the tough choice of when to use their aviation assets. The reality of Army aviation's superiority at night is not fully comprehended by the majority of serving officers. Just as it

has taken many years for the officer corps to learn how and when to employ Army aviation in the daylight, so it will take time to learn how to maximize these assets around the clock. A good training technique may be the use of battle simulations with rules that accurately depict both the advantages and the constraints of operating at night.

SUMMARY

Recent history has shown that it is feasible for both fixed-wing and rotary-wing aircraft to operate successfully against enemy ADA networks. If adequate preparations are made and the necessary survivability equipment is available, losses will be low. If heavily defended targets are attacked without adequate preparation or survivability equipment, losses will be staggering. These and other lessons are addressed in detail under CONCLUSIONS.

III. SOVIET AIR DEFENSE ARTILLERY NETWORK

General

Mission: The Soviets and their Warsaw Pact allies are extremely concerned about the destructive capabilities of NATO aviation assets. To compensate for this, they have constructed the most dense, if not the most effective, air defense artillery network in the world. Over 10,500 surface-to-air missile (SAM) launchers and anti-aircraft artillery (AAA) pieces face NATO alone.[28] The mission of the ADA network is "to protect ground force units and other potential targets from attacks by fixed-wing ground attack aircraft and armed helicopters."[29]

Concepts: Two concepts are paramount to the Soviets in the accomplishment of this mission: (1) Air defense is an integral element of the combined arms concept. (Soviet commanders have recently been harshly criticized in open source material for failing to adequately implement this concept during field exercises.) (2) Air defense is achieved by a variety of weapons and equipment operating together to form a network of air defense. These weapons include not only ADA systems but machine guns, ATGMs and tank main guns. Artillery is also included in the Soviet ADA network to

counter enemy helicopters but there does not appear to be an effective system to integrate it into the air defense surveillance radar and early warning system. It therefore relies solely on visual acquisition and planned or adjusted fires to suppress enemy helicopters. At night the artillery is also responsible for providing illumination to allow all direct fire weapons to engage attacking helicopters. This system, while probably somewhat slow and unresponsive given the Soviet's lack of digital fire control nets and computers, still must be considered by attacking helicopters, which at the very least should avoid firing from obvious registration points.

Capabilities

ADA Units and Systems: Focusing now on Warsaw Pact ADA units, their organizations are as follows:

	Motorized Rifle	Tank
Battalion		
SA-7/14	9	
Regiment		
SA-7/14	30	3
ZSU 23-4/X	4	4
SA-9/13	4	4
Division		
SA-7/14	100+	93
ZSU 23-4/X	16	16
SA-9/13	16	16
SA-6/8/11	20	20

It is indicative of the high priority given to air defense that all systems listed above are shown with a succeeding system which is being fielded or, as with the ZSU 23-4, a new system, the ZSU 23-X, which is being tested. Characteristics and limitations of these current and follow-on systems are shown below. Note that the most plentiful systems, the SA-7/14 and the SA-9/13, are all passive IR homing, requiring visual acquisition to accomplish IR guidance lock-on and that these systems have no night vision

capabilities of any kind. The SA-6 also loses its optical mode at night, rendering it far more vulnerable to suppression and jamming. It is also relevant to note that the ZSU 23-4 is the only ADA gun system still deployed in the first-line Soviet divisions and that, although it has an on-board radar, it is significantly less effective when operating in the radar-only mode. It too is totally lacking in night vision assistance. The same is true of the other older gun systems such as the S-60 which, although obsolete, are still in the lower priority units and could be seen in an extended war.[30]

DIVISIONAL AIR DEFENSE SYSTEMS

	ZSU 23-4	SA-6	SA-7/14	SA-8/B	SA-9	SA-11	SA-1
DOI	1970	1970	1969/80	1974/80	1968	1979	1980
Launch Rails	na	3	1	4/6	2 or 4	3 or 4	4
Guidance	Radar Optical	Radar Homing	IR Homing	Command	IR Homing	Radar Homing	IIR Homing
Max Alt (m)	3500	12,000	4500	12,000	5,000	15,000	9,600
Min Alt (m)	10	50	15	10	10	25-30	INA
Oper Rg (km)	2.5	24	5.5	12	6	30	5-7
Min Rg (km)	0	4	.5	1.6-3	.6	3	INA

Minimum altitude is also a critical factor. Notice that the minimum altitude of only three systems (SA-7/14, SA-6/8/11, SA-9/13) is below 24 meters and that only the SA-8 does not suffer from "night blindness." The SA-8 is, however, mounted on a wheeled chassis and is very thinly armored; therefore the tires, the vehicle itself, and particularly the radar are extremely susceptible to damage by artillery, rockets, etc. The radar is also susceptible to electronic counter-measures (ECM). Except that it is a tracked vehicle, the ZSU 23-4 suffers from the same vulnerabilities.

The GAP: The total systems used for air defense in a tank division are listed below. Note the number of systems that are incapable of effective engagement at night. Only 25% of the ADA systems and 33% of the division overall have a night

capability.

TOTAL SYSTEMS USED FOR AIR DEFENSE

SOVIET TANK DIVISION

	Day	Night degraded	Night
Tanks -main gun	328	328	0
MG	328	0	0
Artillery-SP	90	0	0
SA-6/8/11	20	20	0
SA-9/13	16	0	0
SA-7/14	93	0	0
ZSU 23-4	16	16	0
TOTAL ADA ONLY	145	36 (25%)	
ATGM AT-315	9	9	0
BMP 73MM *	240	240	0
AT-3,4,5	(240)	(240)	0
MG	(240)	(240)	0
BTR-50/60/70 **	31	0	0
BRDM/BRDM-2 **	69	0	0
LMG 5.56mm	526	0	0
TOTAL AA	1866	613 (33%)	0

* Considered as one system (coaxially mounted)

** At least two machine guns each.

There is clearly a significant gap in this network. The Soviets do not have thermal sights for these systems and have only first generation light intensification devices in limited quantities for some of their tank main guns and some antitank guns. Although efforts are being made to develop thermal sights, indications are that, because of their longstanding difficulties in micro-circuitry, computers and miniaturization in general, these efforts are behind schedule and that thermal sights will probably not be fielded until the early 1990s or later. As will be explained later, this vulnerability has significant implication for both helicopters and fixed wing aircraft.

Helicopter Interceptors: In attempting to deal with the

problem of attack helicopters the Soviets have recently identified as a necessity the use of armed helicopters in a counter-helicopter or air superiority role. Jane's Defense Weekly reports the following Soviet quote:

> Therefore it has become vital to get a weapon which could compete with the helicopter in respect of combat power, tactical possibilities, etc. Logic and historical experience suggest that such a weapon is the helicopter itself. Just as tanks have always been the most effective weapon against tanks, helicopters are the most efficacious means of fighting helicopters.[31]

This concept is further substantiated by observed tests of Soviet MI-8 HIP and MI-24 HIND helicopters armed with air-to-air missiles much as the U.S. is doing. The above article goes on to state that the Soviets believe it is "highly likely for a dedicated helicopter-interceptor to emerge in order to fulfill specific missions and that the use of fighter and assault aircraft to interdict helicopters would be a waste of assets."[32] This is probably true for still another reason. Although they have fighters with a look-down capability, they have no air-to-air missile that can operate in that regime.

In absolute confirmation of this approach, the Soviet Union has developed two new helicopters, both of which have a significant air to air capability and may pose a threat to both helicopters and ground attack fighters. The MI-28 HAVOC is believed to be a dual-purpose helicopter capable of both anti-tank and air-to-air combat. In appearance it is a cross between the Soviet MI-24 HIND and the U.S. AH-64 APACHE. It is armed with a turret-mounted 23 mm gun, and will probably carry both a modified AT-6 fitted with a millimeter-wave homing head and podded version of the SA-14. It is also reported to carry a small ranging radar in the nose and has an improved night vision capability (possibly a FLIR) but one which still does not approximate that of the AH-64. The

HAVOC has a maximum airspeed of 300 km/hr and a combat radius of 240 km.[33]

The newest Soviet helicopter is the HOKUM which may have been designed primarily for air-to-air combat. This is suggested by the use of the Advancing Blade Concept (ABC -two main rotors operating in opposite directions) optimized for speed and maneuverability. As such it could give the Soviets a significant helicopter air superiority capability. It exhibits a speed of 350 km/hr with a combat radius of 250 km and carries similar armament to the HAVOC.[34]

Operating in the daylight both helicopters pose a significant threat to the AH-64 APACHE which has an airspeed of approximately 300 km/hr and a combat radius of 240 km, and the AH-1S COBRA with an airspeed of 260 km/hr and a combat radius of 230 km. But in the dark the superior night-fighting capabilities of the APACHE and, to a lesser degree, the C-NITE equipped COBRA give them a clear advantage. These technological advantages will be discussed in detail later in the paper.

These two helicopters do, however, represent a clear commitment to at least dual role helicopter interceptors which could be used to protect the less maneuverable but more numerous HINDs and HIPs. Being armed with some of the latest air-to-air missiles, they also serve as a highly mobile threat to jet aircraft, particularly A-10s. Furthermore they demonstrate a modest improvement in the Soviet helicopter's ability to fight at night. Though certainly not bringing it to the level of the AH-64, they are clearly doing everything within their technological limitations to overcome the significant superiority currently enjoyed by U.S. helicopters.

The U.S. advantage in attack helicopter operations, particularly at night, is being challenged in a historically predictable way. Just as the Soviets believe the tank to be the preferred antitank weapon, so is the helicopter believed to be the best anti-helicopter system. It is therefore obvious, whether we choose to believe and prepare for it or not, that helicopter air-to-air combat will occur in the next

war with the Soviet Union. They will see to it because they believe they have an advantage. We must be ready, day or night.

Summary:

The Soviet Union and the Warsaw Pact have fielded and are continuing to upgrade a dense and relatively effective air defense artillery network which employs all systems on the battlefield. In the daylight any aircraft, either helicopter or jet fighter, flying above the horizons unaided by survivability equipment has a high probability of being hit. But the Soviet system is afflicted with "night-blindness" when opposed by low-flying helicopters and to a lesser degree, low level jet aircraft. Only one-third of their systems normally used to engage aircraft are effective against helicopters operating at night at low altitude particularly at a range of 1000 meters or more. Jet fighters equipped with the Low-Altitude Navigation and Targeting Infrared Night (LANTIRN) system and therefore capable of operating at an altitude of 100 feet on a dark night can enjoy the same advantage. Their current helicopters are likewise ineffective at night and would be easily killed or avoided by helicopters equipped with FLIR or TADS/PNVS, particularly if armed with the STINGER-POST. The next generation (HAVOC and HOKUM) may be more of a challenge. These weaknesses provide a window of vulnerability which can be exploited for several years to come with what is anticipated to be only slowly lessening impunity.

IV. TECHNOLOGY

To take full advantage of this Soviet night blindness, the U.S. is currently testing and fielding or has already fielded several night vision devices and a myriad of other systems which, when synchronized, may result in a significant differential in combat capabilities.

AIR FORCE SYSTEMS

LANTIRN: The primary Air Force system which falls into this category is the LANTIRN. According to the previous Commander, U.S. Air Force Tactical Air Command, (TAC), General Jerome F. O'Mally, the top priority in TAC is the

fielding of the LANTIRN system. General O'Mally stated that "In terms of true night capability today, we (the Air Force) have virtually no capability against small or mobile targets."[35] To execute its portion of the AirLand Battle he felt the Air Force had to have the LANTIRN system. He personally flew the LANTIRN system at 200 feet altitude and 540 knots in the California mountains prior to his death in an unrelated aircraft crash. The LANTIRN system is comprised of a navigation pod, a targeting pod and a heads-up display (HUD). The navigation pod consists of a wide-field-of-view, forward-looking infrared (FLIR) sensor, a terrain-following radar (TFR), supporting electronics and an environmental control unit. It is the less intricate of the two pods and has been flown extensively at altitudes down to 100 feet and 550 mph. The targeting pod is a more intricate system incorporating a FLIR sensor, a laser designator and range finder, automatic target tracking, a missile boresight correlator and extensive supporting electronics and environmental control equipment. Designed to be effective against targets as small as tanks, it experienced significant problems during early testing and was nearly dropped. Changes have been made and subsequent testing has been promising. Although the LANTIRN is not envisioned to be employed against tanks , the ability to hit a target that small clearly allows it to destroy targets like SAM sites, radar vans, command centers, bridges and communications nodes. With the targeting pod it can deliver both laser-guided munitions and Infrared Imaging Maverick. Without it, the LANTIRN system is capable of delivering ordnance accurately on area targets. Pilots who have flown the LANTIRN state that it "enabled them to fly with confidence, as if in the daylight."[36] The biggest drawback to LANTIRN is that it provides only the forward field of view and therefore does not allow for many maneuvers normally used in the daylight such as high "G" turns to terrain masking altitudes and immediate returns to target. LANTIRN also does not have the capability to fly in visibility limited by clouds, precipitation, or fog, but can fly under clouds if the

ceiling permits. By the latter part of the decade this system will be mounted on at least 400 F15Fs with a remaining 300 sets available to other aircraft and to the maintenance effort.[37]

PRECISION MUNITIONS: Minimum exposure, maximum standoff, precision accuracy and high lethality are the desirable traits of Air Force ordnance. To achieve these goals the Air Force has developed a number of weapons, the latest of which have been specifically tailored for low-level, under the weather operations. The AGM-65 Maverick is a television guided missile which allows the pilot to fire and turn away without overflying the target. The newer Imaging Infrared (IIR) Maverick guides on IR emissions from the target, making it suitable for use at night, under weather and in limited visibility. When coupled with the soon to be fielded RAPID FIRE II system (a system which assigns individual targets to each missile) the pilot will be able to engage multiple targets on a single pass. This is especially appropriate for use with LANTIRN where multiple passes will be more difficult.[38]

Another precision munition which is currently available is the GBU-15 glide bomb which uses a TV guidance system attached to a 2000 pound MK 84 bomb. It can be "lofted" toward a target from low level and is extremely accurate. The laser guided equivalent of this is the Paveway system which homes on laser energy reflected from a target by a designator. These targets could be designated by an Army OH-58D AHIP or APACHE aircraft. The new version developed for use at very low altitudes, long standoff and under poor weather is the low-level laser-guided bomb (LLLGB). Both the GBU-15 and the LLLGB may be fitted with autonomous seekers in the future.[39]

The A-10 has proven that there is a place on the modern battlefield for the 30mm cannon. The GPU-5A 30mm gun pod, a derivative of the GAU-8 30mm gun of A-10 fame, is being fielded for use on other ground attack aircraft. This will provide numerous aircraft with the capability to defeat armor targets when weather, terrain or enemy actions make it

impossible to get within launch constraints for other munitions.

MINES: The Air Force has an air delivered scatterable mine system known as GATOR which provides it the capability to stop or at least delay mobile enemy forces. The GATOR mine system consists of two basic air-delivered devices, the U.S. Navy MK7 dispenser, which holds 60 GATOR mines, and the U.S. Air Force SUU-66 dispenser, which holds 94 mines. The BLU-91 is an anti-tank (AT) mine, and the BLU-92 is an anti-personnel (AP) mine. The mix for each dispenser is approximately three AT for each AP. A choice of three self-destruct times is available. The dispenser is released from the aircraft, a linear charge cuts the skin and the GATOR mines are dispersed aerodynamically. The GATOR anti-tank mine uses a magnetic influence fuze and a Miznay-Schardin plate kill-mechanism to provide a full-width kill capability. The GATOR anti-personnel mine has a blast, fragmenting kill-mechanism, which is activated when tripwires are disturbed. The AP mine has a total of eight tripwires, of which at least four will deploy when the mine is emplaced. Both mines weigh approximately four pounds and are cylindrically shaped with a diameter of 4.75 inches and a height of 2.6 inches. The GATOR system will rapidly deliver effective minefields for close air support, battlefield interdiction, battlefield-air interdiction and counter-air operations. These minefields will disrupt and disorganize enemy forces, and deny use of key terrain. Close coordination between U.S. Air Force and U.S. Army units will be required.[40]

ARMY SYSTEMS

The Army is likewise fielding many new and highly capable systems including the AH-64 Apache, the C-NITE FLIR targeting system for the COBRA, the AN/AVS-6 Night Vision goggles, the Multiple Launch Rocket System (MLRS), and Volcano aerial delivered mines. All these systems have a part to play in executing the deep air operation at night.

APACHE: The capabilities of the AH-64 to fight at night using its Target Acquisition Designation System and the Pilot Night Vision System (TADS/PNVS) are presently unequalled in

the world. The TADS provides high-power direct-view optics operating from 3.5 to 16 power magnification. It also has a FLIR, high resolution TV, laser rangefinder/designator, and laser spot tracker. The PNVS provides real-time thermal imagery through integrated helmet and display sight system which also superimposes essential flight data over the imagery allowing the pilot to maintain his scan outside the cockpit.[41]

The armament systems for the APACHE include sixteen HELLFIRE missiles with a range of 7000+ meters, the 30mm chain gun with a range of 3000 meters and a rate of fire of 575-625 rounds per minute and the 2.75" folding fin aerial rocket with a range of 6000 meters. All armament systems are fully integrated with the TADS/PNVS and the fire control computer providing tremendous accuracy with minimal acquisition times for all systems.[42]

The combat survivability of the APACHE is unequalled by any other helicopter in the world today. The combination of dual engine capability combined with greatly improved ballistic tolerance makes it nearly invulnerable to 23mm rounds. This, combined with improved agility, reduced aural, visual, radar and IR signature, and the use of modern tactics taking full advantage of the improved standoff characteristics of its weapons systems, make the AH-64 the most survivable tank-killing helicopter in the world. The Aircraft Survivability Equipment (ASE) complementing this capability includes a passive radar warning device, an IR jammer, chaff/flare dispensers, a radar jammer and a laser detector.[43]

The missions of the AH-64 include all those previously done by the AH-1S plus the greatly increased capability to "go deep" particularly at night and/or in adverse weather. Its improved ballistic tolerance and other ASE systems, coupled with its enhanced armament systems virtually guarantee that the Apache will prove itself to be the most deadly and the most survivable attack helicopter in the world today.

C-NITE: In March 1983 the Vice Chief of Staff of the Army

and the Assistant Secretary of the Army raised questions concerning the feasibility of mounting an inexpensive Forward Looking Infrared (FLIR) on the Cobra fleet to give it a true night fighting capability. In response to these questions, the Cobra Project Manager developed a barebones concept for a low risk, inexpensive system using off-the-shelf components to integrate FLIR and TOW-2 into existing Cobra telescopic sighting units (TSUs). Subsequent research indicated that the M-1 Thermal Imaging Sight matched to the Bradley TOW-2 tracking system was the best combination for a quick, inexpensive fix. The necessary equipment to upgrade all systems to include Laser Airborne Augmented TOW (LAAT) or laser rangefinder was also included. This modification is known as C-NITE and will largely overcome the AH-1S' current inability to effectively engage targets at night and in adverse weather, while also providing the capability to employ the TOW II. It is not the optimal system, such as the TADS/PNVS of the AH-64, but is the best we can afford. Coupled with the AN/AVS-6 (ANVIS) mentioned below, the AH-1S will finally be an around-the-clock attack helicopter, although it will suffer some degradation at night.

Night Vision Goggles (NVGs): NVGs have come a long way since the introduction of the first light intensification devices in the mid-1960's. The first system which allowed aviators to fly blacked out and at NOE altitudes was the AN/PVS-5, a second generation system. The AN/PVS-5 was fielded in 1977 and provides sufficient clarity that, with extensive training, aircraft can effectively be flown at night with some limitation of illumination, weather and speed. The AN/PVS-5 does not provide sufficient clarity to identify such hazards as power lines and are subject to complete white-out if a flare or flash from artillery illuminates in their area. In addition, their weight of 1.9 pounds significantly increases crew fatigue.[44]

The ANVIS or AN/AVS-6 is a third generation image-intensifying device which overcomes many of the shortcomings of the AN/PVS-5. Operating in the red and near infrared portion of the electromagnetic spectrum the ANVIS has

improved the gain and resolution by approximately 25%, enabling the ANVIS to operate in a cloud covered, starlight environment, whereas the AN/PVS-5 required a minimum of 20% moon illumination. White-out due to flares or artillery has also been overcome. Crew fatigue has been reduced and efficiency enhanced by reducing the weight of the system by 50% and evenly distributing over the helmet. The look-under and flip-up characteristics make the ANVIS much easier to use in the cockpit.[45]

MINES: Having developed a true night-fighting capability, the Army is also prepared to slow or stop mobile targets for destruction. The M56 mine system is a helicopter delivered anti-tank (A.T.) mine with a factory set self-destruct time. One UH-1 helicopter can carry two dispensers with 40 mines per dispenser. One sortie can create a minefield 400M X 40M. The M56 anti-tank pressure fuzed mine is a longitudinally split half-cylinder 10.38 inches long by 4.63 inches in diameter. The AT mine is a highly effective track-breaking mine, weighs 5.9 pounds and has an electrical/mechanical pressure fuze. The M56 was developed as an interim system and was partially fielded in 1977 in Europe only. Approximately 41 systems exist in the USAREUR Corps Cavalry Regiments. There are no plans to purchase additional quantities of the M56. USAREUR management of the rebuild program will attempt to extend the M-56 capability for as long as possible. The VOLCANO system is programed to replace the M56 beginning in FY 1987, with completion in FY 1992.[46]

The VOLCANO System will be configured as both a heliborne and ground delivered mine system. The XM139 mine dispenser, with various adaptor kits, will be capable of being mounted on UH-60 helicopters and a variety of ground vehicles. The dispenser racks accept and launch mines from the SM87 mine canisters which contain five GATOR anti-tank and one anti-personnel mines each. The system has a capacity of up to 960 mines and is capable of producing a mined area approximately 1000M X 250M. Air VOLCANO will dispense its full payload in 16 seconds at 120 knots. The VOLCANO mine dispenser will be issued to combat support aviation companies

at four per company.[47]

MLRS: The Multiple Launch Rocket System (MLRS) is designed to provide non-nuclear fire support to include delivery of mines to a division or corps, primarily in the counterfire or suppression of enemy air defense (SEAD) role. With a range of approximately forty kilometers the MLRS fills the gap between direct fire artillery systems and non-nuclear guided missiles. It is a highly mobile and therefore highly survivable system capable of executing an entire fire mission utilizing all or only part of its twelve rockets in under four minutes.[48] Each rocket carries either 644 M77 submunitions which detonate on impact with dual action effects against personnel and light armored vehicles or 336 rocket delivered mines (RDMs). These mines are belly attack mines against which the Soviet mine ploughs are useless. Furthermore, since the crewseats and major subsystems of Soviet tanks bolt directly to the floor, they are especially vulnerable to these type mines. When coupled with anti-disturbance devices, these mines will result in stopping any enemy column if targeted in restrictive terrain.[49] The effect, if executed at night and synchronized with an air attack, would be devastating.

SUMMARY

The U.S. Army and Air Force have identified the Soviet and Warsaw Pact vulnerability of "night blindness" and are continuing to develop and field systems to take advantage of it. In the near term it appears that U. S. aviation can operate with significantly less risk at night and should make every effort to do so, METT-T permitting. This capability coupled with the ability to stop mobile targets or block routes in restrictive terrain offers an opportunity for great success in the deep aerial operation. The Soviets are, however, painfully aware of this weakness and are expending a great deal of resources to overcome it. Taking lessons from both their own history and that of the U.S. they are developing many new systems including the HAVOC and the HOKUM and putting great emphasis on improvement of night vision capabilities. Because of their lack of technology in the

areas of micro-circuitry and computers they will probably catch up slowly if at all. The U.S. and the rest of NATO must continue to capitalize on this significant advantage, not letting faint hearts and fear of the dark keep us from optimizing our strengths for use on the enemy's weaknesses.

V. CONCLUSIONS

RELEVANCE: Although no historical precedent exists which precisely parallels joint deep air operations at night, many relevant lessons can be deduced from the recent historical studies. The relevance and reliability of these lessons become even more certain when supported by the comparative analysis of the Soviet's ADA capabilities and the U.S. and NATO's ability to defeat it. The following observations are the result of that process.

FEASIBILITY: Historical experience since 1945 indicates that it is feasible to conduct both fixed wing and helicopter operations if those operations are properly planned, resourced and prepared. The observations made in the overview from 1945-1973 are supported by the Beqa'a Valley, Falklands and Grenada analyses. Losses to ADA will be acceptable over time but can reach 40-50% if heavily defended targets are attacked without adequate intelligence, aircraft survivability equipment (ASE) and suppression. Furthermore, ground fire from small arms and machine guns, not SAMS, is by far the greatest threat to ground attack aircraft.

NIGHT OPERATIONS: The Soviet Union and every other potential adversary lack a serious night vision capability. This is especially true for ADA and weapons with air defense potential. It is therefore wise to use our present and near term night fighting advantages to conduct combat operations, especially for deep air operations. Even as the Soviet Union fields better night vision systems, some advantages which are inherent to the aerial attacker, such as speed and initiative, will still be magnified at night. Even with night vision devices, visual range and field of view is always less than in the daylight, again providing an advantage to the attacker who knows where he is going, and has sufficient navigation aids to guide him. The defender in most cases must also seek to visually locate a fleeting target which is flying below his radar at high speed. If the defender is in the target area or an area being suppressed,

his situation will be further complicated by incoming ordnance and possibly aerial or rocket delivered mines. These mines will significantly reduce mobility and be extremely difficult to avoid or clear in the dark even with NVGs. Breaching the minefield will be even more difficult if A.T. mines are mixed with A.P. mines using tripwires and/or anti-disturbance devices.

MINES: In the Falklands the Argentines found that the best way to counter the superior British mobility was thru the use of mines. They learned that the use of mines, particularly in terrain to be transited at night, either helicopter-delivered or hand emplaced, served to produce significant casualties and lengthy delays in the British, even when not covered by fire. The concept of entering a minefield with ill-defined limits at night and attempting to clear it when the mine detectors would not pick up the non-metallic mines is overwhelming. Imagine the effects on a column of armored vehicles moving at night well behind the FLOT when it is suddenly immersed in a mine field. This may be an anti-tank (A.T.) mine field delivered directly on the column by MLRS if it is within forty kilometers of the FLOT. The Air Force could provide a GATOR mine field consisting of a mix of anti-armor and anti-personnel (A.P.) mines with trip wires deployed. Army utility helicopters may deliver an A.T. mine field in advance of the column using the M-56 or an A.T./A.P. minefield with the VOLCANO systems. If this situation were further complicated by ATGM fire from unseen attack helicopters and/or direct attacks by Air Force ground attack aircraft equipped with LANTIRN and firing precision stand off munitions, the effects would be catastrophic. The enemy units' ADA would be caught in column and, precluded from deploying by the mines, would be among the first targets destroyed. Follow-on units could not pass on the same route and, even if not attacked, might be thrown well behind schedule.

In deep operations the definition of success is often in delaying or segmenting a large formation while destroying only a portion of it. Mines, either RDMs delivered up to 40

kilometers in front of the FLOT by MLRS, GATOR delivered by jet aircraft or M-56 or Volcano delivered by utility helicopters have a definite place in deep air operations.

MISSIONS:

Army Aviation:

J-SEAD: At night J-SEAD and tactical deception becomes much more difficult for the Air Force. Anti-Radiation Missiles such as the Shrike fired from a Wild Weasel F-4 are still functional, but other munitions requiring visual lock-on or designation are seriously hampered. Aircraft without LANTIRN are also at a disadvantage because they can not drop down to terrain masking altitudes to defeat or evade ADA systems. It is therefore probable that a portion of the J-SEAD program, particularly against targeted ADA systems with minimum altitudes above twenty meters such as the SA-6, can best be attacked by the AH-64s or AH-1s. This may allow the Weasels to concentrate on the tougher SA-8.

Target Designation: Another mission which could best be done by Army aviation, particularly at night, is designation of targets for destruction by laser-guided munitions. For the Air Force to designate requires a significantly longer exposure time by an aircraft in a higher risk envelope. AHIPs or APACHEs can often be more selective or precise in their designation because their presence in the target area need not be known by the enemy.

Aerial Delivered Mines: If mines are to be laid as part of the operation, the MLRS, if in range, is the choice which puts the mines on the ground with the least risk. It does, however, require either communications with the aircraft over an extended distance or precise coordination based on near perfect intelligence. If either the M-56 or Volcano system are used, it will be necessary to carefully scout a break in the column (the Soviets plan to leave large gaps at regular intervals) to overfly the area to be mined. Aerially delivered mines have a definite place in the deep air operation, particularly at night, as was seen in the Falklands.

Electronic Warfare: Electronic warfare will clearly be

a part of most deep air operations. Some facets of this program may best be conducted by elements from the corps aerial exploitation battalion working in conjunction with the Air Force assets. All E.W. must be highly coordinated, probably through the air battle management system.

Downed Aviator Pick-up: Search and Rescue (SAR), although normally an Air Force function, can also be supplemented by Army helicopters. Utility helicopters for command and control, maintenance and downed aviator pick-up will be a part of the Army package and, under control of the Air Battle Captain, may be used to pick up downed air crews as well. Attack helicopter cover may be feasible if it does not detract from the mission. Coordination of this function as well as the use of common downed aviator pick up points is necessary.

Air Force: The mission of the Air Force component of a joint deep air operation will not always require the use of ground attack aircraft. Ground attack aircraft will be essential only when the destruction of the target requires munitions heavier than the TOW II or Hellfire or when the target requires extensive area coverage. In many cases, Air Force packages containing only J-SEAD, AEW/Air Battle Management, ELINT/EW, CAP and/or SAR as needed for that particular mission will be necessary. Consideration should be given to including ground attack aircraft to provide immediate suppression of previously unidentified targets and as a backup to the attack helicopter. If priorities require these aircraft be used elsewhere the mission could often be accomplished without them.

INTELLIGENCE: The Israeli operation in the Beqa'a Valley depended on near perfect intelligence for its success; the British in the Falklands suffered from a lack of it. A joint deep air operation will clearly need the best possible intelligence if it is to succeed with acceptable losses. This will require a thorough and comprehensive Intelligence Preparation of the Battlefield (IPB) plan incorporating all available sources up to and including national assets if available. Clearly, this kind of

intelligence requires time to develop and disseminate, and requires the receiving units to be in close proximity to the All Source Intelligence Centers. The timely sharing of intelligence between the Army and Air Force is essential to insure accurate, synchronized planning and execution. ELINT, TAR and SLAR missions will be required with the timing becoming critical as the operation nears and as it progresses in order to get the most timely and accurate intelligence to the flights and firing batteries. Once launched, intelligence must be fed thru the Air Battle Manager and disseminated to the commanders in the air. The exact techniques of this intelligence process obviously require further study and formulation. It is "best case" and as such would lead to the best possible results with least losses, but the success of every deep operation would not require every facet to fall in to place. It should be remembered, however, that as the intelligence lessens, so do the odds of success with minimal casualties.

COORDINATION: Coordination between the USAF Mission Commander and the Army Air Mission Commander is critical, but the distance and circumstances which separate the two are formidable. It will often not be feasible for the two to get together face to face. Most coordination will be taken from data on the Air Tasking Order and passed through the normal secure communications nets. If all else fails, perhaps the USAF H.F. net could be used "off frequency" to coordinate mission specifics. At a minimum, frequencies, call signs, authentication (if needed), force composition, target locations and types, corridor location and timing, designation of initial points (IPs), downed aviator pick up points and other deconfliction and attack coordination should be accomplished. The more detailed the coordination, the tighter the execution and the greater the synergistic effect. Although we will never have the time to plan and rehearse the precise mission as the IAF did we must plan and train in general in advance so that we can quickly apply the necessary intelligence, coordination and mission planning factors to accomplish the mission with minimal losses. Both commanders

must also discuss the contingencies. At night, even with NVGs, LANTIRN, etc., Clausewitz' friction and fog will be even more pronounced than normal. The commanders must have in their own minds the "what ifs" and "abort criteria". That is probably not when the first item in the order fails to occur properly, but at some point when the operation can no longer accomplish its mission with acceptable loss it should be aborted or modified. This decision can only be made correctly if the commander has a clear understanding of his senior commander's intent two echelons above and an accurate definition of success. A unit which continues beyond these limits will probably face losses similar to those initially inflicted on the IAF in 1973 (30-40%) with a similar lack of long term results.

COMMAND AND CONTROL: A joint deep air operation, particularly at night, is a complex operation with many parts pulled together from across service boundaries. In any operation of this size, it is unreasonable to assume that everything will work exactly as planned every time, or perhaps, ever. It is therefore necessary to recognize that decision making authority must be clearly delineated and delegated down to the lowest possible level. That level must have sufficient information available to make accurate and timely decisions, as was done by the IAF in the Beqa'a Valley raid. In the case of joint deep air operations this means that each service must have a mission commander who is totally in control of his elements. For the Army that will normally be the attack helicopter battalion commander of the unit flying the mission. He will control or coordinate all Army assets including artillery SEAD using his assigned staff. The Air Force commander would be the Mission Commander and would also control or coordinate all Air Force assets.

Furthermore, we must recognize and plan for the fact that all or portions of one force or the other may end up going in alone. This is obviously less than ideal, but there will be situations in war where success, as defined by the higher commander, may be attainable by either the Army aviation or Air Force element alone. Although the joint

operation was clearly preferable, for some reason or another, be it enemy action, weather or pure misfortune, or higher priorities elsewhere, one element may not be able to accomplish all or part of the mission. The remaining element should therefore be prepared to proceed alone if the value of the target is sufficient to warrant the increased risk, and the chances of success are acceptable. These kinds of decisions can best be made and implemented by knowledgeable commanders at the lowest possible level who are totally familiar with the commander's intent and definition of success.

AIR BATTLE MANAGEMENT: There is a distinct need for an air battle management system coupled to an Airborne Early Warning System. It must also be linked to a powerful ELINT capability and the Search and Rescue (SAR) system. It is difficult to imagine that the Soviets, when faced by a sizable aerial package of both helicopters and jet aircraft, capable of inflicting serious damage, would not attempt to oppose it with counter-air fighters and perhaps HAVOCs and HOKUMs. The Air Force has a great deal of experience and expertise at operations of this type, but this experience does not include operating with a sizable Army aviation force. The technical capabilities and techniques of linking these forces are currently lacking. Historical experience indicates this must be solved if joint deep air operations are to be maximized. As was seen in the Beqa'a Valley, decisions are best made by leaders at the appropriate levels who have been provided sufficient, accurate and timely information. This insures retention of the initiative and keeps the enemy reacting. Furthermore, this centralized command, coupled with decentralized execution, results in synchronized operations benefiting from tremendous synergism. In joint deep air operations this may best be done by an Airborne Battle Command and Control Center (ABCCC) with Airborne Early Warning (AEW) provided by an AWACS, supplemented by the on-board radars of F-15s, etc., and elements of the Corps aerial exploitation battalion if the linkage can be established.

AIRSPACE MANAGEMENT: U.S. experiences in Grenada and British experience in the Falklands clearly illustrate the requirement for unity of command, particularly in airspace management. In a mature theater, such as Europe, this is less of a problem, but in a contingency corps operation in the Middle East or Central America where three or more services are involved, there must be only one airspace manager to insure continuity and accuracy. IFF is difficult at best and absolutely impossible if all techniques and codes are not governed by one source.

JOINT TRAINING: In Grenada, Army aviators found that joint training in the form of night carrier qualifications was lacking. The prospect of executing joint deep air operations at night conjures up a myriad of joint training requirements. The procedures for many of these are not yet developed. Many aspects of a deep operation at night are similar to a night JAAT, but, when operating deep in enemy territory rather than on the FLOT, everything is more difficult. For example, if Army aviation elements are used to precisely locate mobile targets, by what techniques will those locations be relayed to Air Force aircraft? Simple visual recognition of friendly aircraft will be difficult. Adjustment of artillery fire or TAC Air on unidentified ADA or other enemy locations is much more difficult at night. Joint deep air operations at night are feasible, but not without carefully thought-out and proven techniques. Adequate time and resources must be dedicated to the development and training of these skills and techniques.

MANNING: The advantages and opportunities of joint deep air operations at night are not without cost. Having developed equipment which can function twenty-four hours a day, we must either increase our pilot to cockpit ratio and our staff manning to support the equipment or force the commander to decide when he wants the support most, because he can not have it around the clock. The logic for an increased pilot ratio is obvious. While deep operations may not be a twice-a-day affair, other operations will also be required, particularly at the division level. Therefore

pilots, and particularly leaders, will be hard pressed to maintain the pace over an extended period. As was the practice of the IAF, Commanders and principal staff officers must be far enough forward to gain the information necessary to make accurate and timely decisions. Around the clock operations requiring continuous planning and the presence of the leaders for execution clearly exceed the capabilities of our present staffs to execute for any appreciable length of time. Just as the British lost as many aircraft to accidents as to direct combat action, so will any force which attempts to operate around the clock at the present manning levels. Worst of all, friendly accidents due to fatigue seldom take a toll on the enemy.

DOCTRINE, MANUALS and MINDSET: The greatest shortfall to be overcome may well be the general mindset of the pilots and leaders in both the Army and the Air Force. Night operations and deep operations each individually conjure up fears of the unknown; together they seem absolutely absurd to many. These fears are not dispelled by our manuals. In the FC 1-111, Combat Aviation Brigade, (Draft), night combat and deep operations are mentioned in several places, but the tone is not positive. The advantage that we will enjoy at night is not stressed. To field the manual at the same time the AH-64, ANVIS and C-NITE are being fielded would be to field an obsolete manual. The equipment should not be fielded without the doctrine in the manuals to optimize its capability. Nowhere in any manual, FM, AFM, or Joint Pam did I find mention of joint night operations. Mindsets change slowly; equipment is fielded much faster. The new manuals and education of our leaders must prepare us to take advantage of the night.

Summary: Deep operations are an essential part of AirLand Battle Doctrine. The conduct of deep operations by both fixed wing and rotary wing aircraft is feasible if the mission is properly planned and prepared, and the aircraft are equipped with adequate survivability equipment. Because of the tremendous reduction in ADA effectiveness at night it is highly desirable to conduct deep air operations during

darkness. Mines, either aerial or rocket delivered, will have an increased effect at night and should be employed to delay mobile targets. Based on these findings, joint deep air operations have the potential to be tremendous combat multipliers. They are capable of hitting high value targets at the time the enemy can least protect them and is least able to counter or respond to the damage. Although certainly not without risk or cost, joint deep air operations can be a deciding factor in the battles of the future.

VI. UNRESOLVED ISSUES

Many of the conclusions stated above leave much room for additional study and development. The salient unresolved issue is timing. How can a target of sufficient value be identified early enough to generate a package to fly against it using the current Air Tasking system? The Air Tasking System requires requests be made seventy-two hours in advance of the issue of the Air Tasking Order (ATO) to be processed within the system. Requests received later than this are treated as immediate requests or diversions of other preplanned missions. Immediate requests and diversions are inefficient, taking assets from other missions without proper regard for overall priorities and not allowing sufficient mission preparation time.

A corollary to this is that the Army aviation element needs a significant period of time to adequately plan and prepare for a deep operation at night. Units in the field often have understandings with their corps commanders that missions across the FLOT at night require forty-eight to seventy-two hours planning time.

An additional complicating factor is the proper management of assets to support night missions. Not all air frames will be equipped or be fully mission capable for night operations. Manning those air frames with properly trained and adequately rested and prepared crews further complicates the problem.

How to resolve these and other issues mentioned above is a significant problem worthy of additional study. If we are

to take full advantage of the opportunities joint deep air operations at night offer we must create a process which can bring all these facets together in a much more timely manner. It must also be done efficiently in order to minimize the impact on other operations.

ENDNOTES

[1] D. L. Holder, "Maneuver In The Deep Battle," Military Review (May 1982) p. 55.

[2] Field Manual 100-5, pp. 3-23 through 3-26.

[3] Holder, p.57.

[4] John Clements, "Air Defense Mythology," Journal of the Royal United Services Institute for Defense Studies (April 1985) p. 28.

[5] Ibid. p. 29.

[6] Ibid. p. 30.

[7] Ibid. p. 32.

[8] William R. Hockensmith, Israeli Air Combat Kill Ratios Over The Beqa'a Valley - How Analogous of USAF Capability Against The Soviets? (rpt. Air Command and Staff College, Maxwell AFB, AL) p. 32. (Hereafter referred to as Hockensmith).

[9] Ibid.

[10] Benjamin Lambeth, "Moscow's Lessons From The 1982 Lebanon Air War," Rand Corporation, A Project Air Force Report (September 1984 p. 1.

[11] Hockensmith, p. 25.

[12] Gary L. Guertner, "The 74-day War: New Technology and Old Tactics," Military Review (November 1982) p. 67. (Hereafter referred to as Guertner).

[13] Jurg Meister, "The Falklands Conflict - Old Lessons, New Weapons," Armada International (June - July 1982) p. 11.

[14] Guertner, p. 72.

[15] "The Falklands Campaign: The Lessons," (December 1982, rpt. Presented to Parliament by the Secretary of State for Defense by Command of Her Majesty, London) p. 18. (Hereafter referred to as Falklands Lessons).

[16] Guertner, p. 67.

[17] Falklands Lessons, p. 22.

[18] D. R. Faint, _The Falklands War: A Search For Military Significance_ (March 1983, rpt. Air Command and Staff College, Maxwell AFB) p. 11. (Hereafter referred to as Faint.)

[19] "Night Vision Capability and the Falklands Campaign," _Armada International_ (September - October 1982) p. 82.

[20] Faint, p. 27.

[21] _Ibid_. p. 30.

[22] David T. Rivard, "An Analysis of Operation Urgent Fury," (April 1985, rpt. 85-2185, Air Command and Staff College, Maxwell AFB, AL) p. 23. (Hereafter referred to as Rivard.)

[23] "JCS Replies To Criticism," _Army_ (August 1984) p. 37.

[24] Rivard, p. 23.

[25] _Ibid_.

[26] _Ibid_.

[27] Grenada Work Group, _Operation Urgent Fury Assessment_ (rpt. U. S. Army TRADOC, Combined Arms Center, Ft. Leavenworth, KS).

[28] "AH-64A APACHE," _Army Aviation_ (31 December 1984) p. 98.

[29] _Ibid_.

[30] Field Manual 100-2-3, pp. 5-89 through 5-95.

[31] "Soviet Intelligence - Combat Helicopter Emerges As A Major Battlefield System," _Jane's Defense Weekly_ (16 April 1985) pp. 583-584.

[32] _Ibid_.

[33] Mark Lambert, "The Soviets Create Havoc," _Interavia_ (January 1985) p. 44-45.

[34] "First Havoc, Now Hokum. What Role For The New Soviet Helicopter?" _Interavia_ (July 1985) pp. 798-799.

[35] Judy J. McCoy and Benjamin F. Schemmer, "An Exclusive Interview With General Jerome F. O'Mally," _Armed Forces Journal International_ (January 1985) pp. 75-76.

[36] James W. Canan, "LANTIRN: Coming On and Coming Up" _Armed Forces Magazine_ (January 1985) p. 34.

[37] Ibid. p. 35.

[38] James P. Coyne, "Coordinating the Air-Ground Battle," Air Force Magazine (October 1985) p. 68.

[39] Ibid.

[40] Dave Czibik, "FASCAM: The Family of Scatterable Mines," (29 April 1985, rpt. Command and General Staff College, Fort Leavenworth, KS: Course A351; New Army Combat and Combat Support Systems). (Hereafter referred to as Czibik.)

[41] "TADS/PNVS and Hellfire APACHE System for Battle," Martin Marietta.

[42] Technical Manual 55-1520-238-10 (28 June 1984).

[43] "APACHE," Hughes Helicopter, Inc., p. 5.

[44] William S, Brophy, "Night Vision Goggles, AN/PVS-5 and AN/AVS-6," (4 February 1985, rpt. Command and General Staff College, Fort Leavenworth, KS).

[45] Ibid.

[46] Czibik.

[47] Ibid.

[48] John M. Cribbs, "Multiple Launch Rocket System (MLRS)" (8 April 1985, rpt. Command and General Staff College, Fort Leavenworth, KS: Course A351; New Army Combat and Combat Support Systems).

[49] Charles J. Dick, "MLRS: Firepower for the 1990's," Journal of the Royal United Services Institute for Defense Studies (December 1983) p. 18.

BIBLIOGRAPHY

Books

Eschel, LTC David, IAF (ret). The Lebanon War. Arco Publishers: New York, NY, 1985.

Grenada Work Group. Operation Urgent Fury Assessment. U.S. Army TRADOC Combined Arms Center: Ft. Leavenworth, KS. (Document classified SECRET. No classified material used.)

Herzog, Chaim. The Arab Israeli Wars. Vintage Books: New York, NY, 1982.

Romjue, John L. From Active Defense To AirLand Battle: The Development of Army Doctrine 1973-1982. Historical Office, U.S. Army TRADOC: Fort Monroe, VA: June 1984.

Pamphlets and Student Papers

Hughes Helicopter, Inc. "APACHE."

Martin Marietta. "TADS/PNVS and Hellfire APACHE System For Battle."

Backlund, William V., Jr. "Can The Army Take Over CAS With Its Organic Aircraft?" Student Report 85-0135, Air Command and Staff College: Maxwell AFB, AL. April 1985.

Brophy, William S. "Night Vision Goggles, AN/PVS-5 and AN/AVS-6." Course A351. Command and General Staff College: Fort Leavenworth, KS 4 February 1985.

Cribbs, John M. "Multiple Launch Rocket System (MLRS)." Course A351. Command and General Staff College: Fort Leavenworth, KS 8 April 1985.

Czibik, Dave. "FASCAM: The Family of Scatterable Mines." Course A351. Command and General Staff College: Fort Leavenworth, KS 29 April 1985.

Faint, D. R. "The Falklands War: A Search for Military Significance." Air Command And Staff College: Maxwell AFB, AL. March 1983.

Gay, Mark P. "The Field Artillery In Support of Deep Offensive Missions." MMAS Thesis, Command and General Staff College, Fort Leavenworth, KS 1985.

Handy, M. L. "The Deep Battle Against Mobile Armored And Mechanized Forces: The Role of the Army of Excellence Corps and Divisional Combat Aviation Brigade." U.S. Army War College: Carlisle Barracks, PA. 28 February 1985.

Herald, David A. "Aerial Exploitation Battalion (Corps Military Intelligence Group)." Course A351. Command and General Staff College: Fort Leavenworth, KS. 1985.

Hockensmith, William R. "Israeli Air Combat Kill Ratios Over The Beqa'a Valley- How Analagous of USAF Capability Against The Soviets." Air Command and Staff College: Maxwell AFB, AL. (Document was classified SECRET, but no classified material was used.)

Hood, Carlton L. "Determining The Optimum Aviation Organization For The Operational Level Of War." MMAS Thesis, Command and General Staff College, Fort Leavenworth, KS. 1984.

McClain, Stephen M. "Problems Associated With The Joint Air Attack Team." MMAS Thesis, Command and General Staff College, Fort Leavenworth, KS. 1982.

Packett, Virgil L. II. "Air Mechanization: The Direction and Dynamics of Army Aviation From A Combined Arms Perspective." MMAS Thesis, Command and General Staff College: Fort Leavenworth, KS. 1985.

Peterman, Robert W. "A J-SAK Summary." (rpt. to Command and General Staff College, Fort Leavenworth, KS). 31 December 1984.

________. "Ground Attack In The Night/Adverse Weather European Environment: How Do We Use The F-111 and What Capabilities Are Needed In The Future?" MMAS Thesis, Command and General Staff College: Fort Leavenworth, KS. 1982.

Rippe, Stephen T. "An Army And Air Force Issue: Principles and Procedures for AirLand Warfare." MMAS Thesis, Command and General Staff College: Fort Leavenworth, KS. 1985.

Rivard, D. T. "An Analysis of Operation Urgent Fury." Air Command And Staff College: Maxwell AFB, AL. April 1985.

Tempton, Willie A.; Anderson, Dean R.; Beasley, Lonnie; Gram Wallace D.; Malaney, Dempsey. "The Corps Aviation Brigade in the Deep Attack." USAWC Military Studies Program Paper: Army War College: Carlisle Barracks, PA. 1 June 1985.

Wilson, Ronald W. "Corps Combat Aviation Brigade In The Rear Battle: A Future Scenario." MMAS Thesis, Command and General Staff College: Fort Leavenworth, KS. 1985.

Articles and Periodicals

Ashey, Bob. "J-SEAD (Joint Suppression of the Enemy's Air Defenses): Doing It Together." Field Artillery Journal. April 1985, Vol 53, pp. 51-53.

Babiasy, Frank E. "The Leak in the Soviet Air Defense Umbrella." Aviation Digest. November 1981, pp. 35-37.

Barbara, James C. and Brown, Robert F. "Deep Thrust on the Extended Battlefield." Military Review. October 1982.

Barry, Charles L. "Planning Aviation Cross - FLOT Operations." Military Review. January 1984, Vol 64, pp. 34-45.

Bellamy, Chris. "Antecedents of the Modern Soviet OMG." Journal Of The Royal United Services Institute For Defense Studies. September 1984, pp. 50-58.

Bussert, Jim. "Soviet Air Defense (AD) Systems Show Increasing Sophistication." Defense Electronics. May 1984, pp. 75-76.

Canan, James W. "LANTIRN: Coming On and Coming Up." Air Force Magazine. January 1985, Vol 68, pp. 34-42.

Cardwell, Thomas A. III. "One Step Beyond - AirLand Battle, Doctrine Not Dogma." Military Review. April 1984, pp. 45-53.

Clements, John. "Air Defense Mythology." Journal Of The Royal United Services Institute For Defense Studies. September 1982, Vol 127, pp. 25-35.

Cordesman, Anthony. "NATO C3I: The Problem of Security." Armed Forces Journal. December 1984, p. 56.

Coyne, James P. "Coordinating the Air-Ground Battle." Air Force Magazine. October 1985, pp. 65-70.

Dick, Charles J. "MLRS: Firepower for the 1990'.s" Journal Of The Royal United Services Institute For Defense Studies. December 1983, pp. 17-22.

Galvin, John R. "Warrior Preparation Center: USAF/Army Hammer Out Close Cooperation." Armed Forces Journal International. August 1984, Vol 122, pp. 98-99.

Geiger, Geo John. "Red Havoc." Marine Corp Gazette. October 1985. pp. 48-49.

Gueritz, E. F. "The Falklands: Joint Warfare Justified." Journal Of The Royal United Service Institute For Defense Studies. September 1982, Volume 127, pp. 46-55.

Guertner, Gary L. "The 74-Day War: New Technology and Old Tactics." Military Review. November 1982, Volume 62, pp. 65-72.

Holder, L. D. "Maneuver in the Deep Battle." Military Review. May 1982, pp. 54-61.

Kyle, Deborah and Meyer, Deborah. "Has NATO C3I Gone Haywire?." Armed Forces Journal. December 1982, p. 62.

Kennedy, Ollie P. "The AirLand Battle - An Opportunity to Excel." U.S. Army Aviation Digest. February 1984, pp. 13-15.

Lambert, Mark. "The Soviets Create Havoc." Interavia. January 1985, pp. 44-45.

________. "First Havoc, Now Hokum." Interavia. July 1985, pp. 798-799.

Lindberg, Leonard. "Night Vision Systems." Defence Science and Electrionic. April 1984, Volume 4, pp. 21-24.

Ludvigsen, Eric C. "Army - Air Force Reach Accord on AirLand Effort." Army Magazine. July 1984, Volume 34, pp. 55-56.

McCoy, Judy J. and Schemmer, B. F. "An Exclusive AFJ Interview with GEN Jerome F. O'Malley, Cdr, USAF, TAC." Armed Forces Journal, January 1985, pp. 71-76.

McKenzie, James B., Jr. "ALFA Agency." U.S. Army Aviation Digest. March 1985, Vol 31, pp. 14-15.

Maddox, Bobby J. "Landpower's Third Dimension." Army Magazine. March 1984, Vol 34, pp. 18-21.

Meister, Jurg. "The Falklands Conflict - Old Lessons, New Weapons." Armada International. June-July 1982, Vol 6, pp. 6-11.

Moore, Jeremy and Woodward, John. "The Falklands Experience." Journal of the Royal United Services Institute for Defense Studies. March 1983, Vol 128, pp. 25-32.

Mullady, Brian P. "Soviet Air Defenses - Part I: The Philosophy, U.S. Army Aviation Digest. May 1982, pp. 31-35.

_______. "Soviet Air Defences - Part II: "Individual Weapons." U.S. Army Aviation Digest. June 1982, pp. 32-35.

_______. Soviet Air Defenses - Part III: ZSU 23-4 SHILKA." U.S. Army Aviation Digest. August 1982, pp. 34-37.

Robinson, Clarence, Jr. "Surveillance Integration Pivotal In Israeli Successes." Aviation Week and Space Technology. July 1982, p. 16.

Rosler, Rolf. "Thermal Imagery Units - Methods, State of Development, Trends." NATO's Sixteen Nations. November - December 1984, Vol 29, p. 88.

Seigle, Robert N. and Mitchell, James W. "Looking Back at Urgent Fury." Army Aviation. December 1983, Vol 32, pp. 18-24; 57-58.

Stanton, Ray. "U.S. Army Aviation Board Adds New Dimension." U.S. Army Aviation Digest. January 1985, Volume 31, pp. 13-16.

Taylor, John W. R. "(LANTIRN) Jane's Aerospace Survey 1985." Armed Forces Magazine. January 1985, Vol 68, pp. 62-70.

Editorial. "AH-64A APACHE." Army Aviation. 31 December 1984, pp. 97-99.

Editorial. "ALFA (AirLand Forces Application Agency) Bridging the Gap." Field Artillery Journal. March - April 1985, pp. 21-23.

Editorial. "Beqa'a Valley Combat." Flight International. October 1982, pp. 1108-1111.

Editorial. "JCS Replies To Criticism." Army. August 1984. pp. 28-37.

Editorial. "Night Vision Capability and the Falklands Campaign." Armada International. September - October 1982, p. 78-82.

Editorial. "SEAD Suppression of Enemy Air Defense." Field Artillery Journal. September - October 1980, pp. 8-18.

Editorial. "Soviet Computing." Jane's Defense Weekly. 19 October 1985, pp. 866-867.

Editorial. "Soviet Intelligence - Combat Helicopter Emerges As A Major Battlefield System." Jane's Defense Weekly. 16 April 1985, pp. 583-584.

Government Reports and Studies

Dines, Kerry and Hines, John. Soviet Front Fire Support. DDB-1130-8-82, Department of Defense Intelligence Agency: Washington, D.C. September 1982.

Lambeth,Benjamin. Moscow's Lessons From The 1982 Lebanon Air War. RAND/R-3000-AF, Rand Corporation: Santa Monica, CA. September 1984.

CACDA. Operational Concept For Corps Deep Attack As Part Of The AirLand Battle. Deep Attack Study Group, U.S. Army Combined Arms Combat Development Activity: Fort Leavenworth, KS. August 1985.

TRADOC. Antihelicopter. Operational Effectiveness Analysis Using Carmonette. Vol 1. Executive Summary. TRASANA-TR-39-83-VOL-1. U.S. Army TRADOC Systems Analysis Activity, White Sands Missile Range, NM; November 1983. Document is CONFIDENTIAL, but no classified information was used.

Foreign Government Reports

"The Falklands Campaign: The Lessons." A special report presented to Parliament by the Secretary of State for Defense by Command of Her Majesty, London. December 1982.

U.S. Army Publications

U.S. Army Training and Doctrine Command. TRADOC Pamphlet 525-43, JOINT OPERATIONAL CONCEPT AND PROCEDURES FOR COORDINATION OF EMPLOYMENT OF AIR DELIVERED MINES (J-MINE). U.S. Army Training and Doctrine Command: Fort Monroe, VA; 24 September 1984.

U.S. Army Training and Doctrine Command, TRADOC Pamphlet 525-16, JOINT OPERATIONAL CONCEPT JOINT ATTACK OF THE SECOND ECHELON (J-SAK). U.S. Army Training and Doctrine Command: Fort Monroe, VA; 13 December 1982.

U.S. Army Training and Doctrine Command, TRADOC Pamphlet 525-45, GENERAL OPERATING PROCEDURES FOR JOINT ATTACK OF THE SECOND ECHELON (J-SAK). U.S. Army Training and Doctrine Command: Fort Monroe, VA; 31 December 1984.

U.S. Army Training and Doctrine Command, TRADOC Training Text 17-50-3, JOINT AIR ATTACK TEAM OPERATIONS. U.S. Army Training and Doctrine Command: Fort Monroe, VA; 31 October 1983.

U.S. Army Training and Doctrine Command, TRADOC Training Text 100-44-1, JOINT SUPPRESSION OF ENEMY AIR DEFENSES (J-SEAD) OPERATIONS. U.S. Army Training and Doctrine Command: Fort Monroe, VA; 11 June 1982.

Department of the Army, Field Circular No. 1-111, COMBAT AVIATION BRIGADE. U.S. Army Aviation Center: Fort Rucker, AL; 28 February 1985.

Department of the Army, Field Circular No. 1-112, ATTACK HELICOPTER BATTALION. U.S. Army Aviation Center: Fort Rucker, AL; 29 March 1985.

Department of the Army, Field Circular No. 1-113, COMBAT AVIATION BATTALION. U.S. Army Aviation Center: Fort Rucker, AL; 29 March 1985.

Department of the Army, Field Circular No. 1-140, HELICOPTER GUNNERY. U.S. Army Aviation Center: Fort Rucker, AL; 29 March 1985.

Department of the Army, Field Circular No. 100-181, U.S. AIR FORCE BASIC DATA. U.S. Army Command and General Staff College: Fort Leavenworth, KS; May 1984.

Department of the Army, Field Manual No. 1-100, COMBAT AVIATION OPERATIONS. Washington, D.C.; U.S. Government Printing Office, 28 September 1984.

Department of the Army, Field Manual No. 1-107, AIR-TO-AIR COMBAT. Washington, D.C.; U.S. Government Printing Office, 12 October 1984.

Department of the Army, Field Manual No. 100-2-1, THE SOVIET ARMY OPERATIONS AND TACTICS. Washington, D.C.; U.S. Government Printing Office, 16 July 1984.

Department of the Army, Field Manual No. 100-2-2, THE SOVIET ARMY SPECIALIZED WARFARE AND REAR AREA SUPPORT. Washington, D.C.; U.S. Government Printing Office, 16 July 1984.

Department of the Army, Field Manual No. 100-2-3, THE SOVIET ARMY TROOPS, ORGANIZATION AND EQUIPMENT. Washington, D.C.; U.S. Government Printing Office, 16 July 1984.

Department of the Army, Field Manual No. 100-5, OPERATIONS. Draft; U.S. Army Command and General Staff College: Fort Leavenworth, KS; July 1985.

Department of the Army, Technical Manual No. 55-1520-238-10, OPERATOR'S MANUAL FOR ARMY AH-64A HELICOPTER. Washington, D.C.; U.S. Government Printing Office, 28 June 1984.

Special Reports and Unpublished Material

Letter, Headquarters, United States Army Aviation Center and Fort Rucker, AL, Dated 29 July 1985; subject: "Phase I and II of Airland Battle Study.

END

FILMED

DTIC

6-86